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Advanced Supported Liquid Membranes for Carbon Dioxide Control in Cabin Applications

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The development of new, robust, life support systems is critical to NASA's continued progress in space exploration. One vital function is maintaining the carbon dioxide (CO_2) concentration in the cabin at levels that do not impair the health or performance of the crew. The CO_2 removal assembly (CDRA) is the current CO_2 control technology on-board the International Space Station (ISS). Although the CDRA has met the needs of the ISS to date, the repeated cycling of the molecular sieve sorbent causes it to break down into small particles that clog filters or generate dust in the cabin. This reduces reliability and increases maintenance requirements.

Another approach that has potential advantages over the current system is a membrane that separates CO_2 from air. In this approach, cabin air contacts one side of the membrane while other side of the membrane is maintained at low pressure to create a driving force for CO_2 transport across the membrane. In this application, the primary power requirement is for the pump that creates the low pressure and then pumps the CO_2 to the oxygen recovery system.

For such a membrane to be practical, it must have high CO_2 permeation rate and excellent selectivity for CO_2 over air. Unfortunately, conventional gas separation membranes do not have adequate CO_2 permeability and selectivity to meet the needs of this application. However, the required performance could be obtained with a supported liquid membrane (SLM), which consists of a microporous material filled with a liquid that selectively reacts with CO_2 over air. In a recently completed Phase II SBIR project, Reaction Systems, Inc. fabricated an SLM that is very close to meeting permeability and selectivity objectives for use in the advanced space suit portable life support system. This paper describes work carried out to evaluate its potential for use in spacecraft cabin application.

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